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Plantz et al.

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(54) **SPRAYER**

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(51) **Int. Cl.**

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B01F 5/04	(2006.01)
B01F 13/00	(2006.01)
B05B 7/24	(2006.01)
B05B 12/00	(2006.01)

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CPC . ***B05B 7/30*** (2013.01); ***B01F 5/043*** (2013.01); ***B01F 5/0413*** (2013.01); ***B01F 13/002*** (2013.01); ***B01F 13/0027*** (2013.01); ***B05B 7/2418*** (2013.01); ***B05B 7/2424*** (2013.01); *B05B 9/0816* (2013.01); *B05B 12/004* (2013.01); *B05B 15/0208* (2013.01)

(58) **Field of Classification Search**

CPC B05B 7/30; B05B 7/2418; B05B 7/2424; B05B 9/0816; B05B 12/004; B05B 15/0208; B01F 5/0413; B01F 5/043; B01F 13/002; B01F 13/0027

USPC 239/318, 142, 394, 396, 436, 302, 310, 239/317, 337, 338, 340, 342, 353, 354, 364, 239/367, 373, 375, 391, 392, 397, 407, 433, 239/437; 222/331, 335, 400.7

See application file for complete search history.

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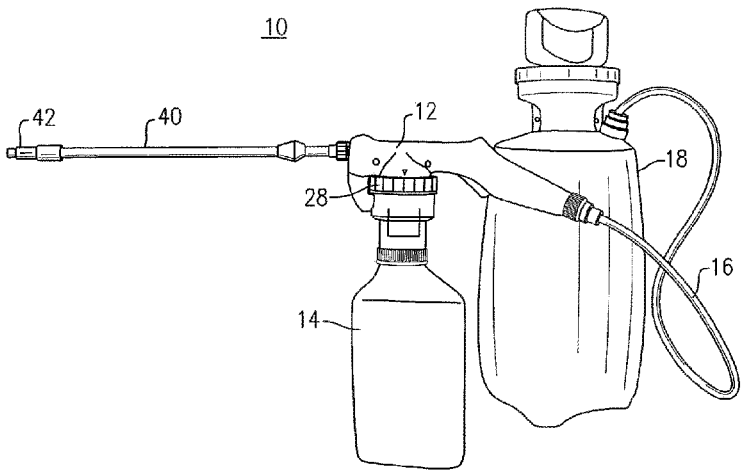
(57) **ABSTRACT**

A sprayer system having a sprayer assembly adaptable to a variety of sizes and shapes of containers. The sprayer assembly includes a dual venturi in the flow conduit to provide even pressure and consistent flow in the spray volume. A metering device is coupled to the flow conduit for accurate and reliable regulation of mixture ratios. A dip tube, coupled to the fluid conduit, is adaptable to a variety of container orifices. In addition to acting as a conduit for passage of concentrate into the sprayer assembly, the dip tube may also be used as a cutting device to open the container into which it will be inserted. By adapting to a variety of container orifices, the dip tube allows the sprayer assembly to fit to a variety of containers.

12 Claims, 7 Drawing Sheets



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B05B 15/02 (2006.01)
B05B 9/08 (2006.01)

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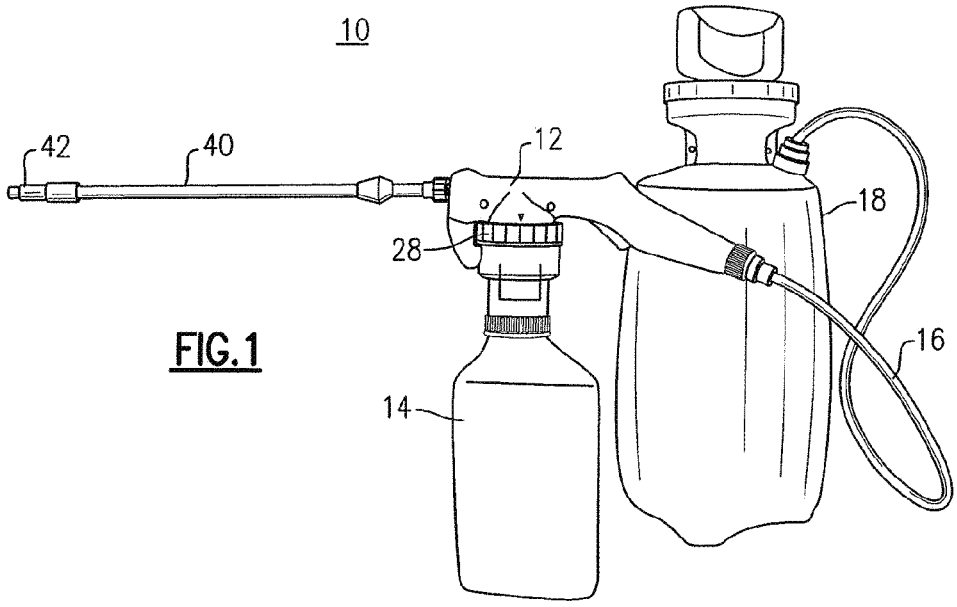

FIG.1

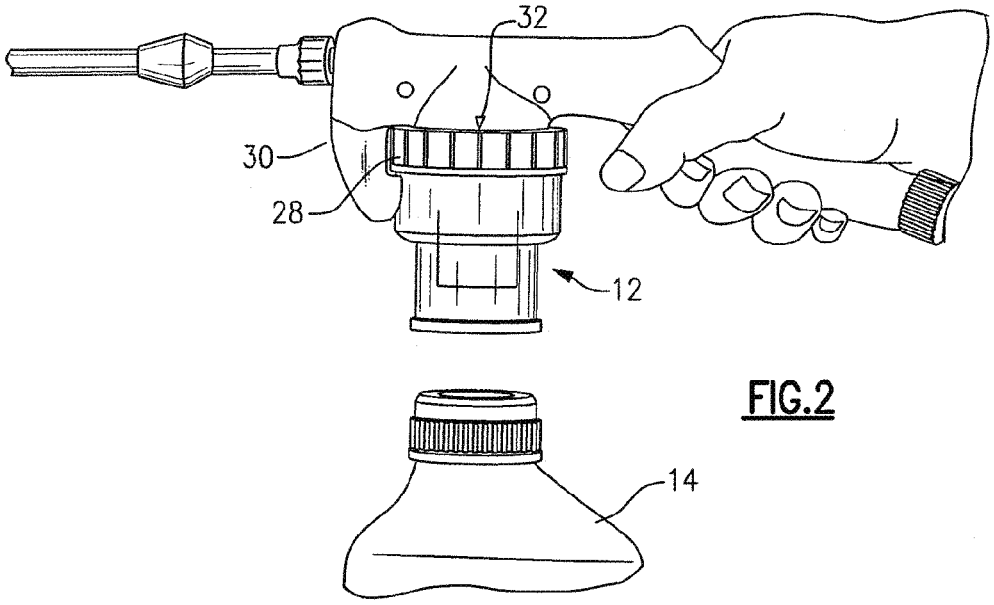

FIG.2

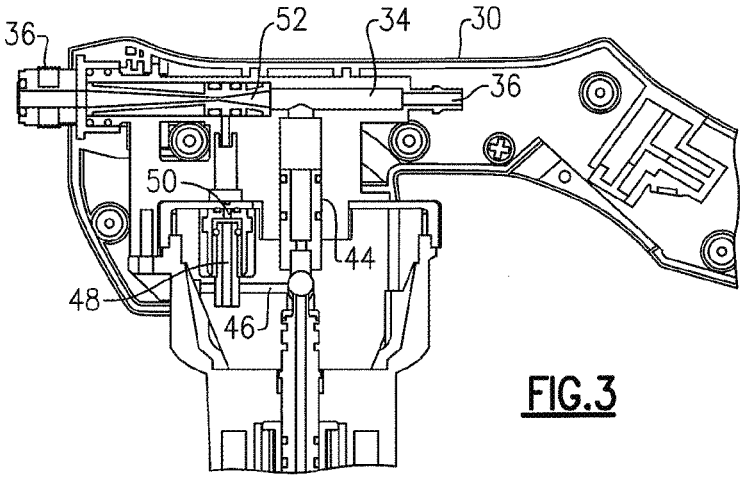

FIG.3

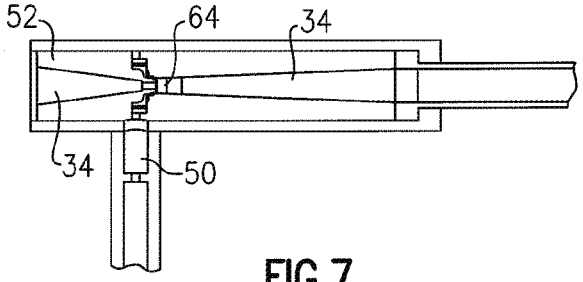

FIG.7

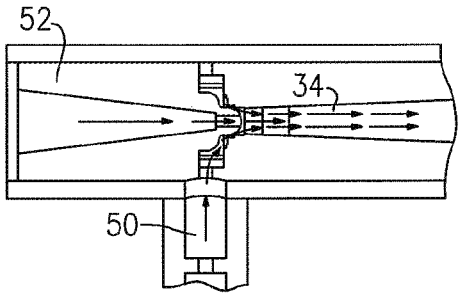

FIG.8

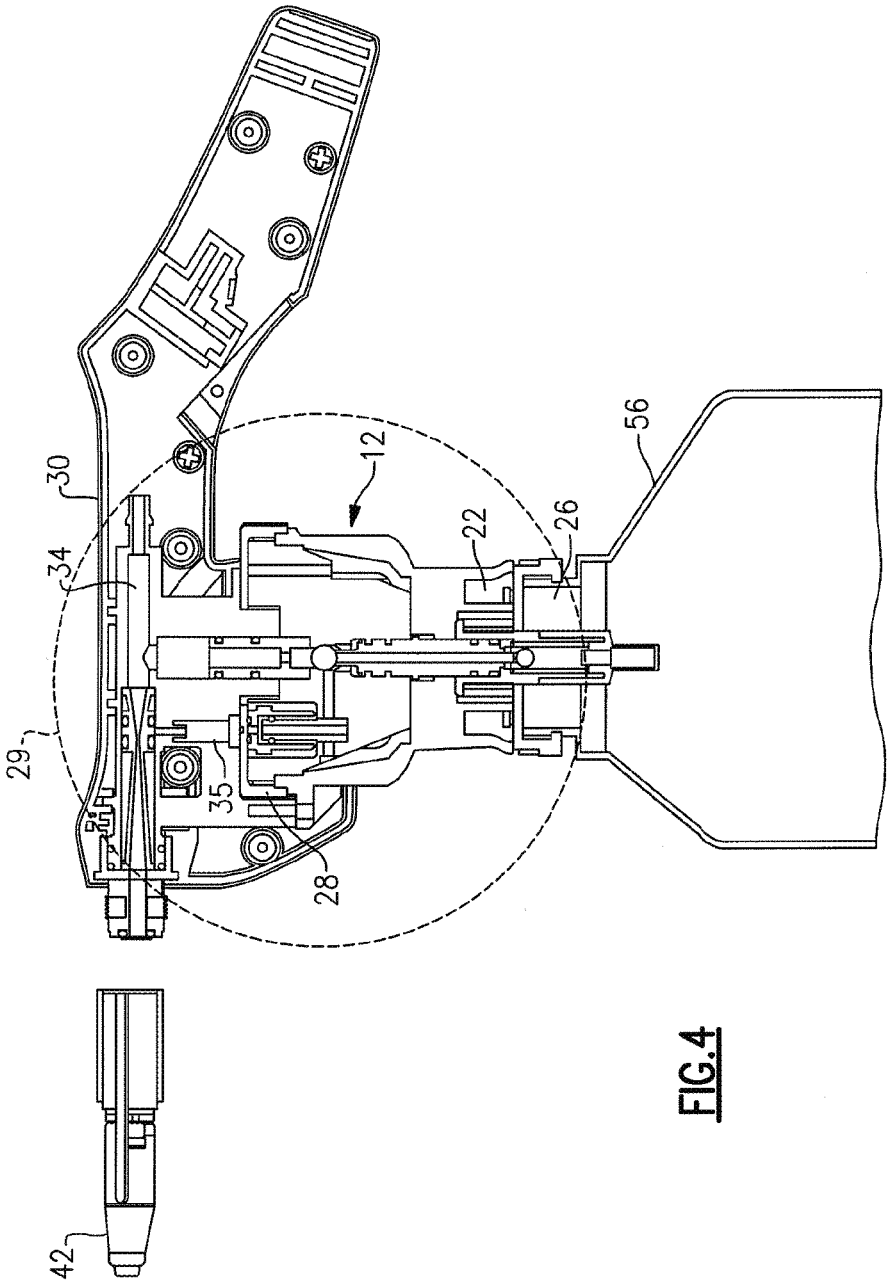

FIG.4

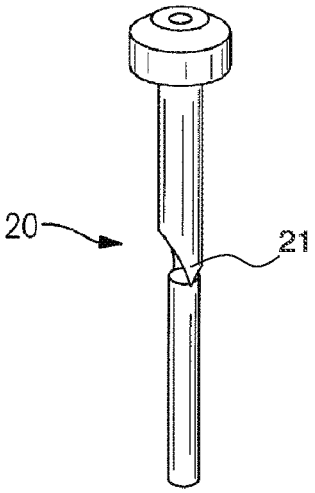

FIG.5A

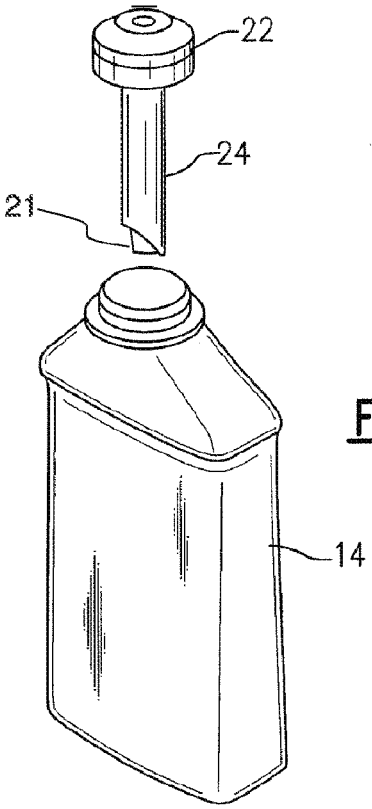

FIG.5B

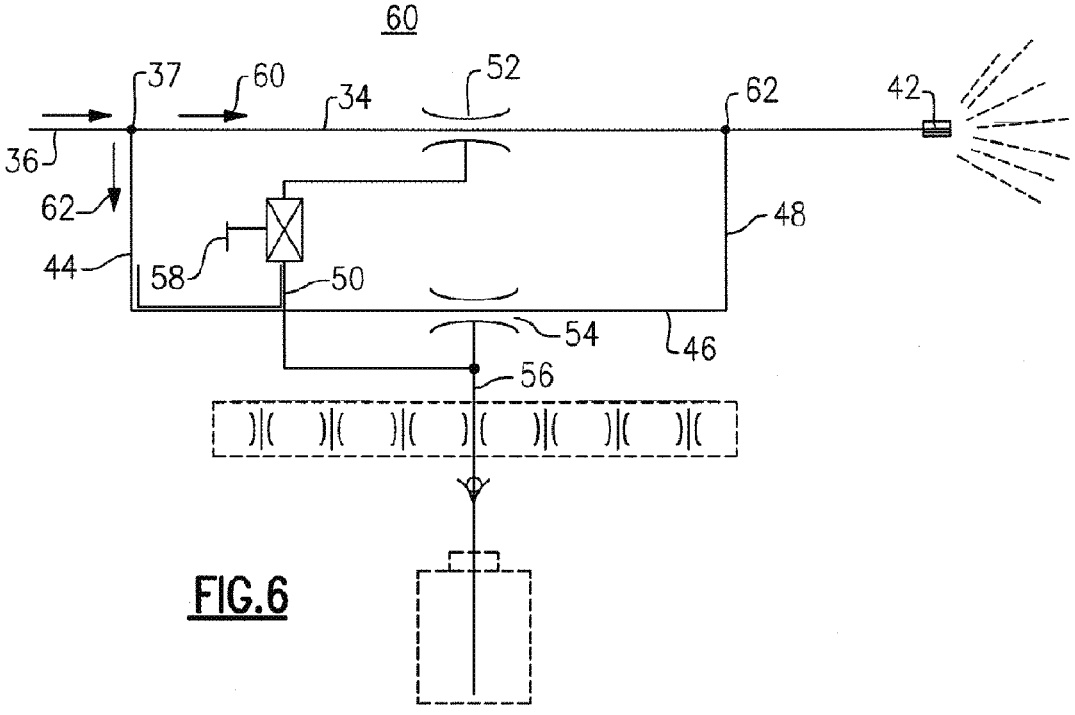

FIG.6

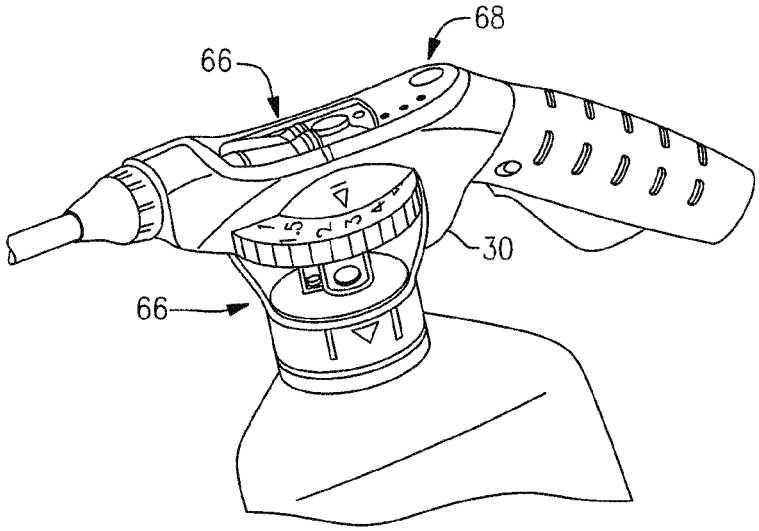

FIG.9

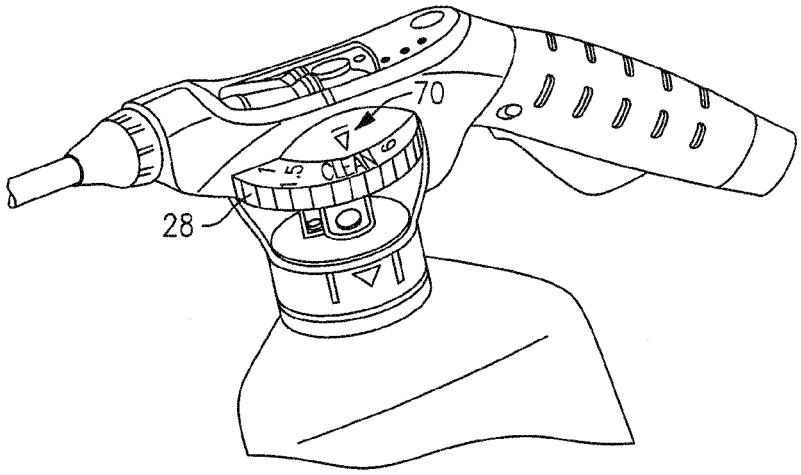

FIG.10

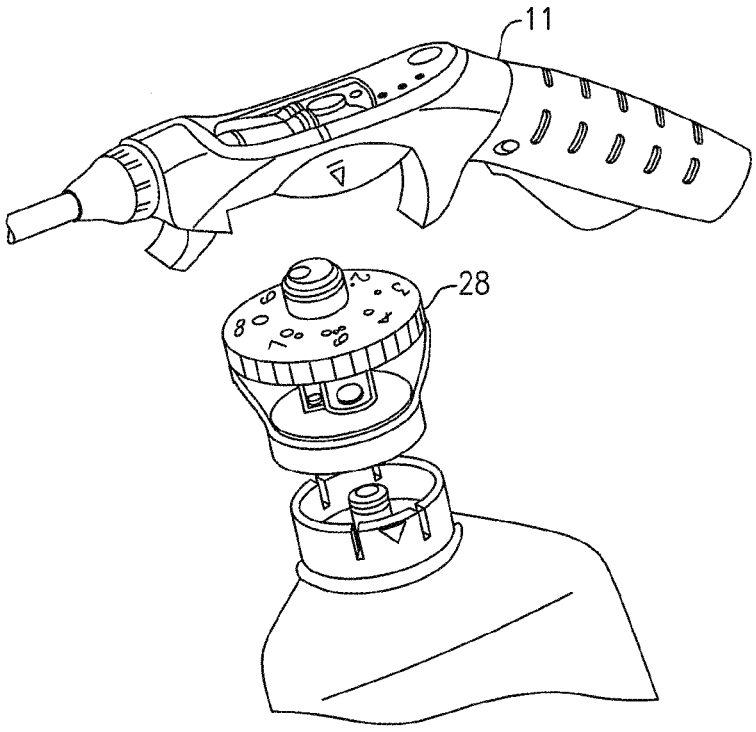

FIG.11

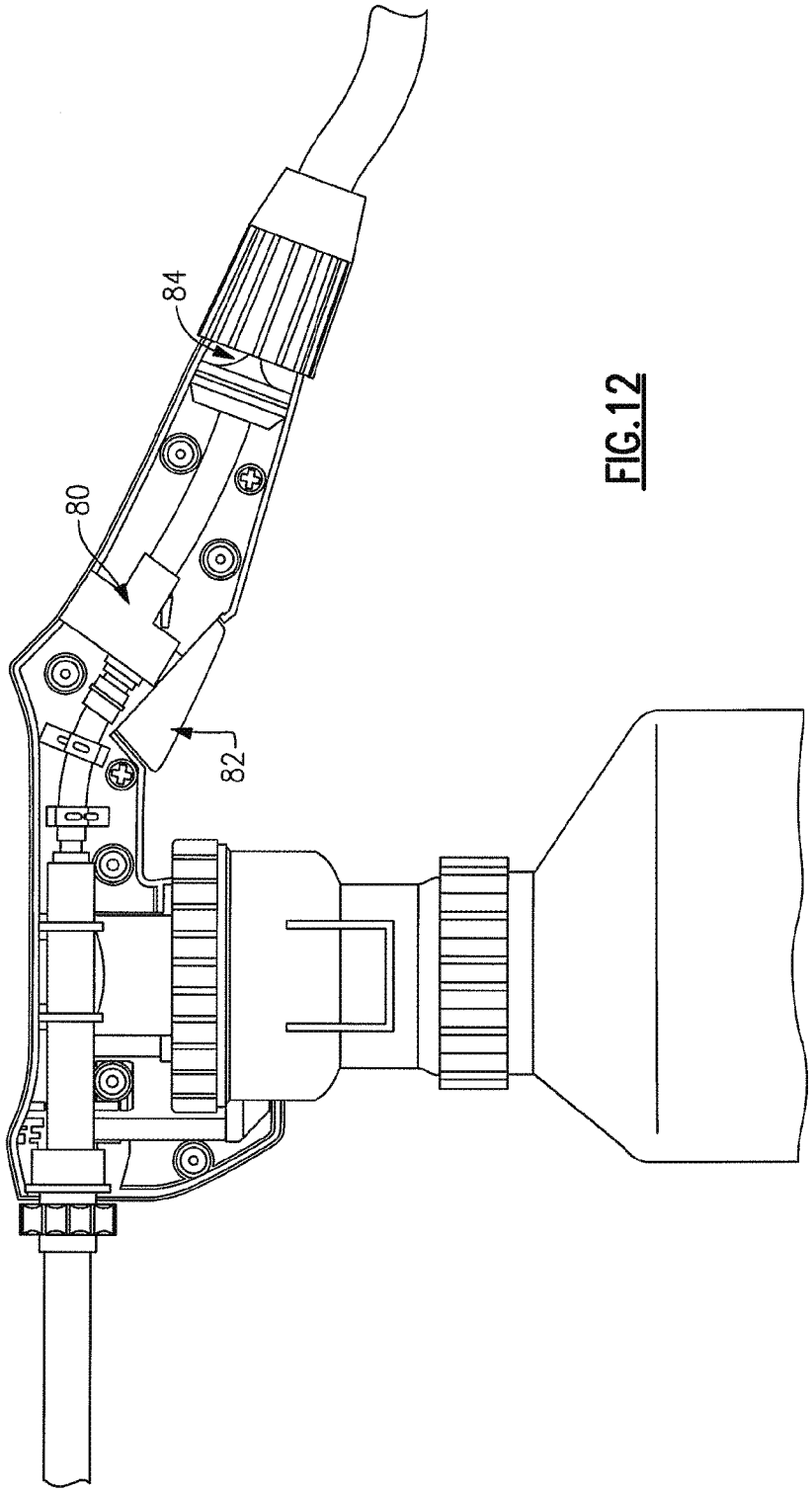

FIG. 12

SPRAYER

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a continuation of and claims priority to Applicant's U.S. patent application Ser. No. 12/206,973, filed Sep. 9, 2008, now allowed.

BACKGROUND

The present invention relates generally to spraying devices, and more particularly to spraying devices adaptable to a variety of containers.

Typical lawn and garden tank sprayers that apply fertilizers, pesticides or other chemicals require a fixed dilution ratio by the addition of water thereto to provide a liquid spray mixture. There are considerable energy requirements necessary to provide adequate pressure to atomize and propel the liquid mixture into a spray. This entails manual pumping of air into a pressure chamber and building up of the pressure to a magnitude that creates an adequate spray pattern for the application, which can be manually demanding for the user. The user will also periodically pump the pressure back up to its operating pressure to re-establish the proper spray pattern, disrupting the spray process, prolonging the time it takes to complete a spray application.

Currently available garden hose-end sprayers that incorporate aspirating units, utilize a series of orifices to meter the concentrate side of the system to achieve a preset mixing ratio. For example, the popular Dial N Spray™ unit available from Scotts Miracle-Gro Company uses various orifices in a rotational disk that are calibrated and labeled so that the user only needs to set the dial to the correct setting to achieve the desired mixing ratio. Downstream pressure fluctuations, sometimes present with adjustable nozzles, can affect the metering accuracy of these aspirating units. Additionally, when back pressure is created in the spray nozzle, the venturi will not operate below atmospheric pressure, resulting in a change or actual stop in the flow. The mixture ratio is also affected. These changes in the mixture ratio will in turn affect the efficacy of the spraying application.

Furthermore, many of the sprayers on the market require premixing of the chemicals and water, exposing the user to chemicals and the potential for spilling of the chemicals during mixing. Initial opening of the concentrate bottle cap and typical foil seal can be difficult to break. The user usually uses a sharp tool to break the seal. There is a high probability that the tool will get concentrate on it when it punctures the foil. The tool and the process of opening the foil seal expose the user to accidental spillage of the concentrate. Sometimes a transfer container is used to measure the amount of concentrate, which is then transferred to the sprayer. There are exposure risks in this process associated with cleaning and storage of the transfer container. The user is required to manually measure out the recommended quantity of concentrate with a spoon, cap or other measuring device. The concentrate is then added and diluted with a known volume of water in the sprayer tank for use in the application. It is possible that the premixing and transfer process can deposit concentrate on undesirable surfaces of the sprayer resulting in yet more exposure to chemicals.

It is a primary object of an embodiment of the invention to provide a sprayer system that eliminates or reduces the user's exposure to concentrate and diluted chemicals. It is another object of an embodiment of the invention to provide a sprayer system that does not require premixing of concentrate and water. It is a further object of an embodiment of the invention to provide a sprayer system that reduces or eliminates the environmental and other problems associated with spraying of chemicals, storage of chemicals, proper disposal of chemicals and clean-up of chemicals. It is yet another object of an embodiment of the invention to provide a sprayer system that is adaptable to any type of container. It is a further object an embodiment of the invention to provide a sprayer system having an accurate and reliable metering component. It is a further object of an embodiment of the invention to provide a sprayer system that is easy to clean. It is a further object of an embodiment of the invention to provide a transparent and visual indication of the fluid movement, mixing and filtering process. It is still another object of an embodiment of the invention to provide a sprayer system that is ergonomically designed and requires little or no effort to operate. It is a further object of an embodiment of the invention to allow only clean water in the pressurized sprayer tank.

SUMMARY OF THE INVENTION

These and other objects and advantages are accomplished by a sprayer system having a sprayer assembly adaptable to a variety of sizes and shapes of containers. In one aspect of an embodiment of the present invention, the sprayer assembly includes a dual venturi in the flow conduit to provide even pressure and consistent flow in the spray volume. In another aspect of an embodiment of the invention, the sprayer assembly includes a metering plate for accurate and reliable regulation of mixture ratios. In yet another aspect of an embodiment of the invention, the sprayer assembly includes a dip tube that is adaptable to a variety of container orifices. In addition to acting as a conduit for passage of concentrate into the sprayer assembly, the dip tube may also be used as a cutting device to open the container into which it will be inserted. By adapting to a variety of container orifices, the dip tube allows the sprayer assembly to fit to a variety of container orifices. The sprayer assembly easily couples to the dip tube for adaptability to different types of containers.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will be more fully understood and appreciated by reading the following Detailed Description in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view of an embodiment of the sprayer system of the present invention;

FIG. **2** is a perspective view of an embodiment of the sprayer assembly of the present invention;

FIG. **3** is a partial cross-sectional view of an embodiment of the sprayer assembly of the present invention;

FIG. **4** is a partial cross-sectional view of an embodiment of the sprayer assembly of the present invention;

FIG. **5***a* is a perspective view of an embodiment of the dip tube of the sprayer system of the present invention;

FIG. **5***b* is a perspective view of an embodiment of the dip tube and container of the sprayer system of the present invention;

FIG. **6** is an embodiment of a metering circuit diagram of the fluid flow pattern through the sprayer system of the present invention;

FIG. **7** is a fragmented view of an embodiment of the spray assembly of the present invention showing the venturi;

FIG. **8** is a fragmented view of an embodiment of the spray assembly of the present invention showing the venturi;

FIG. **9** is a partial perspective view of an embodiment of the sprayer assembly of the present invention;

FIG. **10** is a partial perspective view of an embodiment of the sprayer assembly of the present invention;

FIG. **11** is a partial perspective view of an embodiment of the sprayer assembly of the present invention; and

FIG. **12** is a partial perspective view of an embodiment of the sprayer assembly of the present invention.

DETAILED DESCRIPTION

As will be appreciated, an embodiment of the present invention provides a spray system **10** as shown in FIG. **1**, having a spray assembly **12** for convenient adaptation to a container **14** for withdrawal, mixing and dispensing of the ingredients from container **14**. Container **14** typically holds additives such as chemical or fertilizer ingredients that must be mixed with another fluid, such as water. Spray assembly **12** includes a flexible hose **16** for attachment to a fluid source, such as a water tank **18**. It is understood that the fluid source may be any of a variety of structures including back pack tanks, hand portable tanks or even tractor transported tanks.

Spray assembly **12** is able to cooperate with container **14** via a dip tube **20**, shown in FIGS. **5***a* and **5***b*. Dip tube **20** is inserted in container **14** to draw the ingredients therethrough to spray assembly **12**. Dip tube **20** includes a head portion or cap **22**, a shaft **24**, and a cutting component **21**. Cap **22** is adjustable and can fit onto a variety of container orifice sizes to connect thereto. As shown in FIG. **4**, head portion **22** of dip tube **20** is coupled to orifice **26** of container **14**. A multiple number of different-sized caps **22** may be provided with dip tube **20** to provide a precise fit to container **14** or any container that needs to attach to spray assembly **12**. Accordingly, dip tube **20** and cap **22** are easily switched from one container to another, allowing for the use of different chemicals for different applications, using the same spray assembly.

In a further aspect of the invention, spray assembly **12** includes a metering device **28** to provide variations in the ratio of components being mixed together. Metering device **28** is coupled to fluid conduit **29** and is located on housing **30**, which housing further encases the components of spray assembly **12**. The ratio of ingredients in container **14** to fluid, such as water, in tank **18**, can vary from use to use, depending upon the application. Also, since the system may be used with different containers and therefore different ingredients, the different ingredients may require different mixing ratios with water. Metering device **28** addresses all of these needs by providing options for a variety of ratios including ratios of chemical concentrate to water in the range of 500:1 to 4:1. Examples of ratios that may be provided by device **28** include, but are not limited to, 0.25 concentrate:0.75 water, 0.50 concentrate:0.50 water, or 0.75 concentrate:0.25 water. Device **28** is set at the preferred ratio by turning the dial to match the preferred ratio at arrow **32** positioned above device **28**.

Reference is made to FIGS. **3**, **4** and **12** which show the internal components in housing **30** of sprayer assembly **12**. The internal components include a fluid conduit **29**, which includes all the passages in sprayer assembly **12** for the flow of fluid and concentrate therethrough. A longitudinally extending passageway **34** is coupled to flexible hose **16** (shown in FIG. **1**) at the inlet side **36** of passageway **34** and continues to outlet **38**. A shut-off valve **80** is linked to passageway **34** and flexible hose **16** and connected to trigger **82**. As trigger **82** is pressed, water is allowed to flow through passageway **34**. By releasing trigger **82**, shut-off valve **80** blocks water from flowing through to passageway **34**. This protects hose **16** and container **18**. A filter **84** may be positioned proximate the fluid entrance end in housing **30** and may be easily cleaned as needed.

Outlet **38** can be connected to a long shaft **40**, which is further connected to a spray nozzle tip **42**, as shown in FIG. **1**. Passageway **34** is also connected to passageway **44**, which is positioned perpendicular to passageway **34**. Passageway **44** is further connected to passageway **46**, which runs perpendicular to passageway **44** and parallel to passageway **34**. Passageway **46** connects to passageway **48**, which is connected to passageway **34**, to complete the loop. Passageway **46** also connects to passageway **34** via passageway **50**. A check valve **35** is positioned above passageway **50** to protect container **14** from any backflow of fluid. One venturi **52** is positioned within passageway **34** and another venturi **54** is positioned within passageway **46**. The venturi effect created by the dual venturi pulls concentrate from container **14** to mix with water in the fluid conduit **29**. The dual venturi arrangement provides a high pressure spray resulting in an even and continuous spray volume.

It should be mentioned that in the discussion that follows, FIGS. **6** through **8** are mirror images of FIGS. **1** through **4** with respect to the conduit circuit and the fluid flow. The fluid flow in FIGS. **1** through **4** is from right to left and the fluid flow in FIGS. **6** through **8** is from left to right.

Reference is made to FIG. **6**, which shows dual venturi circuit **60** of the present invention and clearly illustrates the flow pattern of the mix (concentrate and water) through spray system **10**. A main venturi **54** is located in passageway **46** and a secondary venturi **52** is located in passageway **34**. Concentrate from container **14** is pulled upward through dip tube **20** to passageway **56**. A shutoff valve **58** is located in passageway **50**. If shutoff valve **58** is open, concentrate can flow through two pathways. That is, it can flow through both passageway **46** to spray nozzle **42** and passageway **50** to passageway **34** to spray nozzle **42**.

Water enters through flexible hose **16** at inlet **36** and is directed into two separate pathways at point **37**. It flows down passageway **44** as shown by arrow **62**. From passageway **44** it moves into and through passageway **54** and through main venturi **54**, mixing with concentrate at venturi **54**, which mixture continues up passageway **48** through passageway **34** to spray nozzle **42**. The second pathway the water stream follows is in passageway **34**. If shut off valve **58** is open, concentrate moves up passageway **50** and mixes with water in passageway **34** at the second venturi **52**. This water/concentrate stream meets the first water/concentrate mixture at point **62** and the mixtures flow together out through nozzle **42**. If shut off valve **58** is closed, only water flows through passageway **34**, adding to the water/concentrate mixture at point **62**, and flowing out through spray nozzle **42**. Accordingly, depending upon the volume of water necessary in the mixture, if more water is needed, the shut-off valve is closed and if less water is needed, the shut-off valve is left open. Shut-off valve **58** is controlled by metering device **28**.

Reference is made to FIGS. **7** and **8**, which show venturi **52** in passageway **34**. Concentrate moves up passageway **50** and enters the venturi throat, at which point it mixes with water in passageway **34**. This venturi design has an optimal throat diameter for the range of flow rates and mixture ratios used in this spray assembly **12**. This venturi allows for more energy efficiency mixing of the water and the concentrate because both are flowing in the same direction.

The tuning of the size and flow characteristics of the spray nozzle and the venturi are very critical for achieving the proper atomization and spray patterns for lawn and garden applications. The spray nozzles used in garden sprayers are designed to work within their typical operating pressures. In

the venturi design, there is a pressure loss downstream of the venturi throat due to the friction losses from geometry changes in the flow path and the mixing of different velocity streams in the throat. The spray nozzle is designed to have a flow coefficient in the range of from about 0.2 to about 0.4 gallons per minute and to provide a droplet size in the range from about 200 to 600 microns with adequate pattern shape and distribution. The spray nozzle design also has different spraying modes that have the same flow coefficient. This nozzle design provides the correct fluid pressure distribution and flow rates to allow the correct mixture ratios over the operating pressure range and different nozzle settings.

In another aspect of the invention, reference is made to FIG. **9**, which illustrates details of housing **30**. Housing **30** may be fabricated of any suitable material that is resistant to and compatible with the chemical fluid to be sprayed. Examples include, but are not limited to, different types of polymeric materials such as polyethylene and polypropylene, and metal, such as stainless steel. In the preferred embodiment, the housing **30** and other fluid components are fabricated of clarified polypropylene to allow the user to view chemical fluid as it passes through the system to determine when fluids are mixing. Sections **66** on housing **30** are transparent or translucent to allow the user to view the fluid passing through the system. Housing **30** may be entirely clear throughout or in only specific sections, as shown in FIG. **9**. A flow indicator **68** also may be included on housing **30** to indicate whether the system is functioning as required.

In a further aspect of the invention, sprayer assembly **12** may include a self cleaning cycle as a spray option on metering device **28**. As illustrated in FIG. **10**, a CLEAN cycle **70** is included on metering device **28**. This self cleaning option flushes water through sprayer assembly **12** removing all traces of chemicals in the fluid conduit **29**, shaft **40** and spray nozzle **42**. This prevents aggregation and clogging of particles in nozzle **42** and fluid conduit **29** and allows the user to clean sprayer assembly **12** without having to remove spray assembly before cleaning has occurred. This further eliminates or reduces the user's exposure to chemicals.

As an another option, spray assembly **12** may be easily disassembled for cleaning. FIG. **11** shows sprayer **11** and metering device **28** as separate components, which easily disconnect, if further cleaning is necessary.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended embodiments.

What is claimed is:

1. A sprayer assembly for engaging an additive source comprising:

a dip tube for insertion in an additive source, whereby the dip tube is configured to engage the additive source;

a housing configured to engage the dip tube;

a fluid conduit disposed in the housing for coupling to the dip tube, wherein the fluid conduit includes a dual venturi in parallel;

a first inlet

a second inlet;

an outlet; and

a flexible hose having a first end and a second end, wherein the second end is connected to a fluid source having fluid therein;

wherein the first inlet is connected to the flexible hose, the second inlet is connected to the dip tube, and the outlet is connected to a spray nozzle;

wherein the fluid conduit comprises a first passageway connecting the first inlet to the outlet, and a second passageway connecting the second inlet to the outlet, and wherein the dual venturi comprises a first venturi in the first passageway and a second venturi in the second passageway; and

wherein the fluid and the additive are mixed in the fluid conduit and expressed from the outlet through the spray nozzle.

2. The sprayer assembly of claim **1** where the housing comprises a metering device coupled to the fluid conduit to regulate ratios of a mix.

3. The sprayer assembly of claim **2** wherein the metering device comprises a dial.

4. The sprayer assembly of claim **3** wherein the metering device comprises a plurality of mixing orifices and wherein the plurality mixing orifices are associated with one or more pathways.

5. The sprayer assembly of claim **4** wherein the plurality of mixing orifices activate the dual venturi.

6. The sprayer assembly of claim **1** wherein the dip tube comprises a cap for engaging the additive source.

7. The sprayer assembly of claim **6** wherein the dip tube fits a plurality of different-sized caps.

8. The sprayer assembly of claim **6** wherein the dip tube fits a plurality of different-sized bottle necks.

9. The sprayer assembly of claim **1** wherein the dip tube comprises a cutting component.

10. The sprayer assembly of claim **6** wherein the dip tube comprises a cutting component positioned on the underside of the cap.

11. The sprayer assembly of claim **1** wherein the fluid conduit comprises one or more check valves for protecting the additive source.

12. A sprayer system comprising:

a container having an additive source therein;

a metering device coupled to the additive source;

a spray nozzle;

a fluid conduit having a fluid input, a fluid output and a dual venturi system, wherein the dual venturi system is coupled to the fluid input and the additive source, and further wherein the fluid conduit comprises a first passageway and a second passageway, wherein the dual venturi system comprises a first venturi in the first passageway and a second venturi in the second passageway; and

a nozzle coupled to the fluid output;

wherein the fluid and an additive are mixed in the fluid conduit and expressed from the spray nozzle.

* * * * *